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(54) Pipe stabilizing mat

(57) The manufacture of a flexible stabilizing and protection mat for pipelines and other installations comprising a plurality of elongate blocks spaced apart and interconnected by flexible ropes, each block being formed by a tubular member of plastics material which is filled with a concrete mix so as to encapsulate the portion of the rope and any reinforcing rods or mesh contained within the tubular members which become a permanently retained encasement of the blocks thus formed. Inwardly projecting parts of hook means within the first and last tubular members will also be encapsulated by the concrete filling. The tubular members may be provided with one or more fins projecting from their outer surfaces.

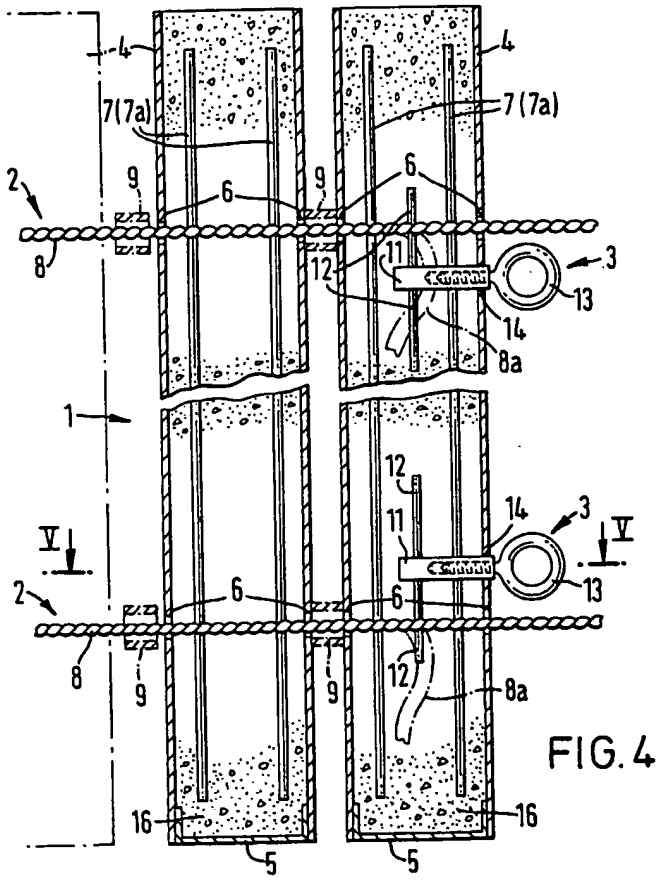

FIG. 4

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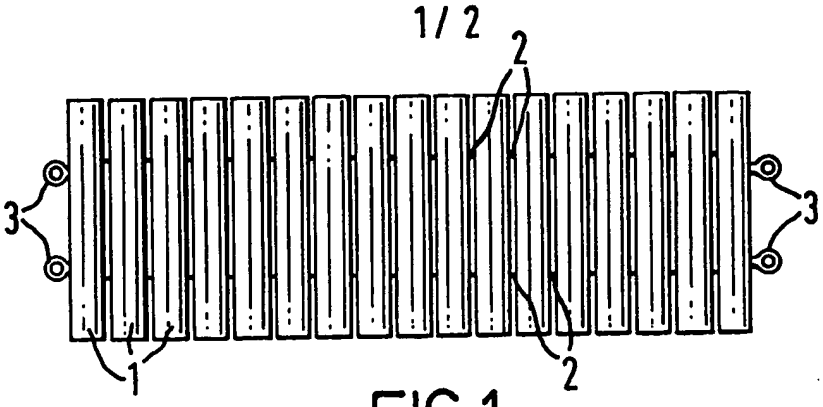

FIG.1

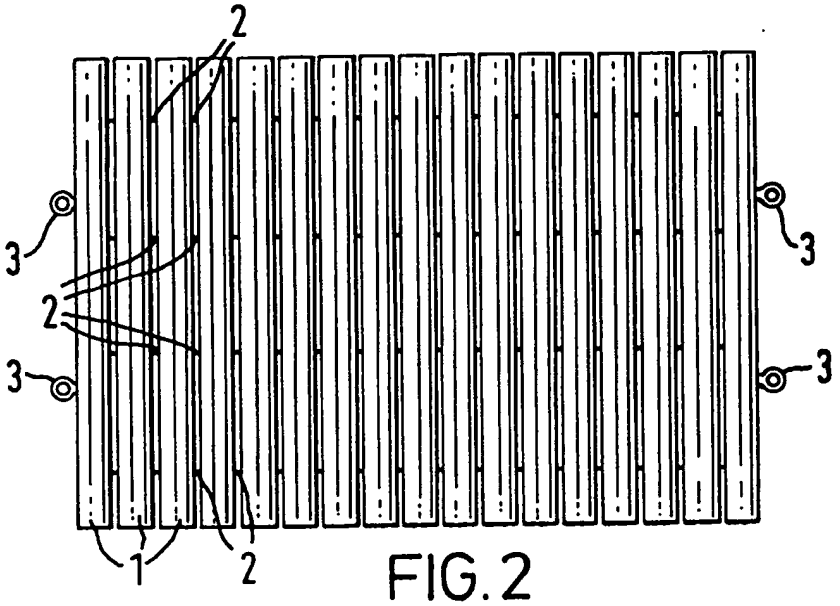

FIG.2

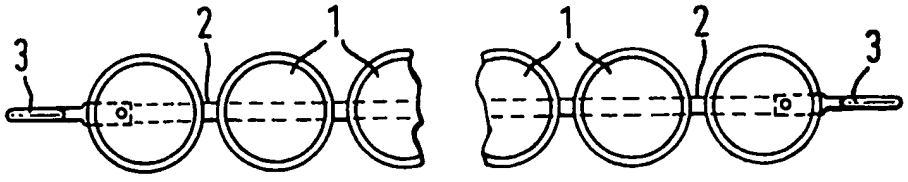

FIG.3

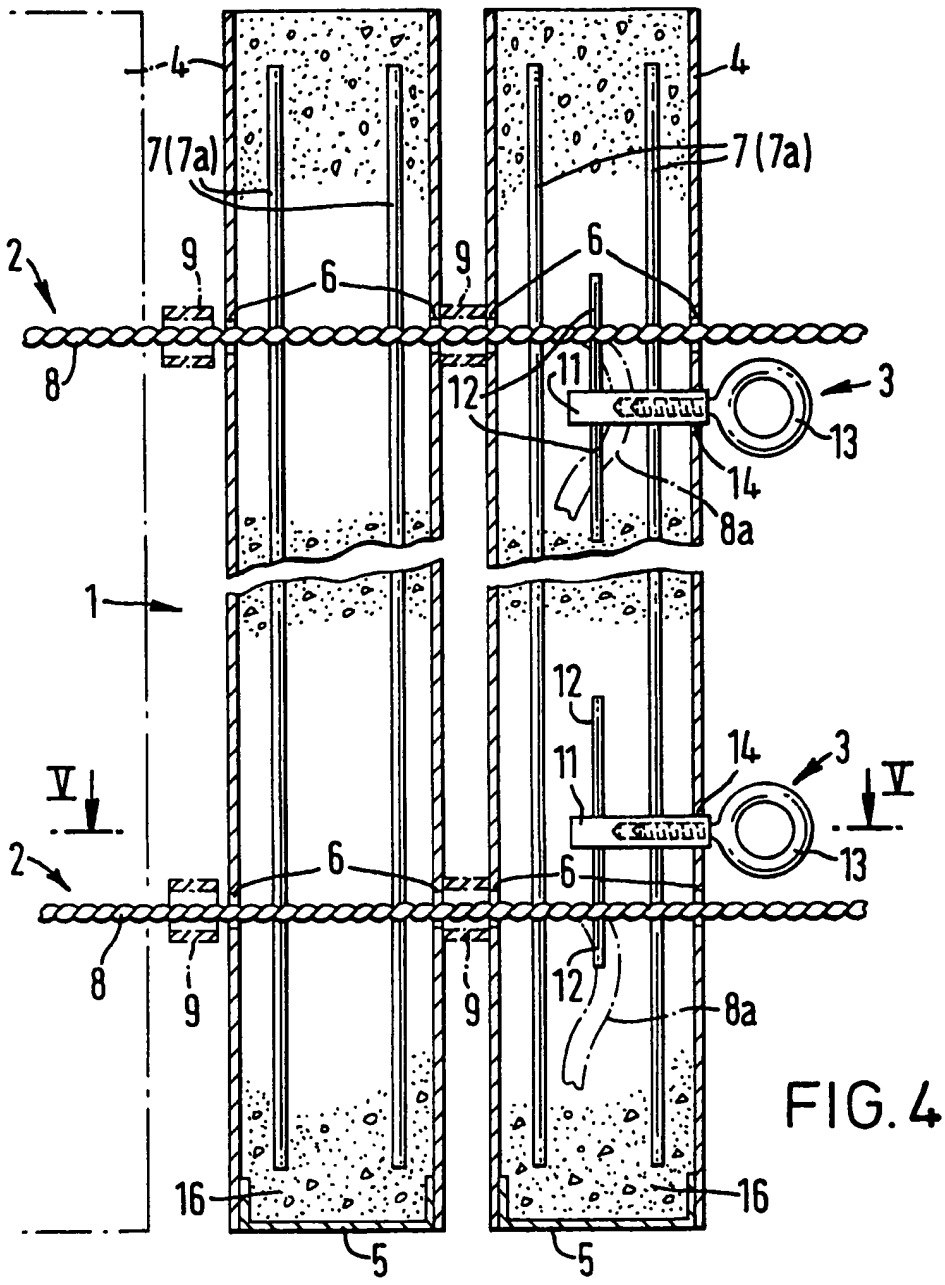

FIG. 4

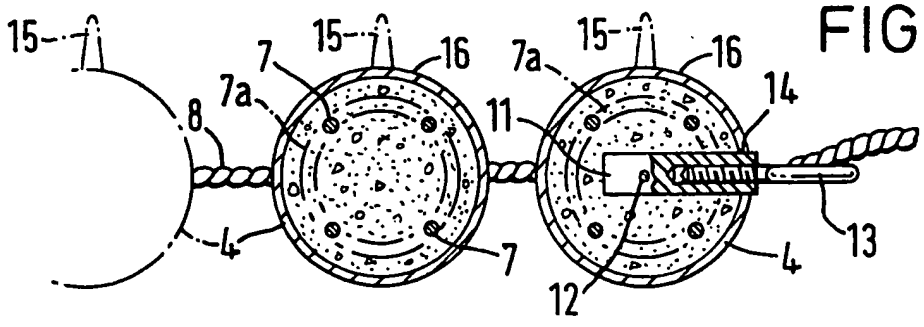

FIG. 5

SPECIFICATION

A stabilizing and protection mat for underwater installations

This invention relates to stabilizing and protection mats used to ballast and protect underwater installations, particularly, gas or oil pipelines on the sea bed or river bed.

The invention is particularly concerned with such mats of the kind each comprising a plurality of elongate cast concrete bars disposed in side-by-side spaced relationship with each other and connected together by flexible connectors so as in use to enable the flexible mat to be draped over or against a pipeline (usually with the assistance of divers) with its ends resting on the sea or river bed at either or both sides of the pipeline. In practice, a number of these mats are draped at intervals along a length of the pipeline considered in need of ballasting and protection particularly from the undesirable effects of erosion of the sedimentary bed, scouring, and damage sometimes caused by trawler line tackle and the dragging of ships anchors or anchor cables which can result in the loss of areas of concrete coating usually applied to the exterior surfaces of a pipeline.

Known mats of the kind referred to are found to be very expensive since they require significant amounts of capital investment, time and labour in providing and setting up moulds or shuttering which have to be retained during at least partial curing of the concrete. Also additional time has to be allowed for complete concrete curing after the moulds are removed before the mats can be used. Thus, the cost of producing many hundreds of these known kinds of mats required to stablize and protect e.g., many miles of natural gas offshore pipelines are thought to be unacceptably high, and an object of the present invention is to provide an improved form of flexible pipeline stabilising and protecting mat whose design and method of manufacture considerably reduces the cost and the time taken to manufacture the product and has other beneficial advantages.

According to the present invention, in a method of manufacturing a flexible pipeline stabilizing and protection mat, there is provided a plurality of elongate tubular members closed at one end thereof and each formed with at least two pairs of holes spaced apart along its length, the holes of each pair of holes being substantially co-aligned in diametrically opposed walls of the tubular member, at least two lengths of flexible rope each of which is threaded through the respective aligned pairs of holes of the tubular members which are arranged in predetermined spaced parallel relationship with each other along the ropes, the first and last tubular members of said plurality of tubular members are provided with hook means, the tubular members then being filled from their open ends with concrete which completely encapsulate and anchor the portions of rope contained within the tubular members which become a permanently retained encasement part of each of the flexibly interconnected bars formed thereby.

In some cases the encased concrete bars may be further strengthened by inserting within each tubular member, before it is filled with concrete, a number of reinforcing metal rods or a pre-prepared cage of metal wire mesh which is supported within the tubular member and through which said rope portions will also be threaded or entwined, the reinforcing rods or mesh together with the rope portion being encapsulated by the concrete filling to reinforce the concrete.

The hook means, which can be of any suitable form, are used for connecting to the lifting tackle of a supply vessel for lifting and then lowering the mat towards the pipeline using for example, a spreader beam in well known manner which keeps the ends of the mat spread apart during the lowering operation and enables a diver to manouver the mat more easily into a draped position over the pipeline.

In one form, for example, the hook means may consist of at least two screw-threaded socket members which are permanently fixed in each of the first and last encased concrete bars with access to the screw thread being provided through apertures formed in the outer wall of each first and last tubular member, and into each of which socket members a screw-threaded eye bolt is fitted. The eye bolts can conveniently be removed from the socket members by the divers for re-use with another mat once it is in position over the pipeline.

Preferably, the socket parts of the hook means are initially supported in said apertures in the wall of the appropriate first and last tubular members before the concrete filling is applied with an extended portion of each socket projecting within the tubular member whereby also to be encapsulated by the concrete filling. Alternatively, the sockets can be fixed to the appropriate encased concrete bars at a later stage of manufacture thereof.

The tubular members may be formed from plastics material, for example, polythene or polypropylene which has the advantages of being resistant to impact damage, and which can conveniently be cut lengths of readily available piping. To enable the mats to be easily located in the murky environment on the sea bed, the plastics material of the members can be of an easily recognisable bright colour with at least one of the central members being of a contrasting bright colour to the remaining members so as to enable the divers to more easily manouver the mat centrally over the pipeline.

The use of tubular members made of plastics material also facilitates the production of cross-sectional shapes for the finished bars more suitable for encouraging precipitation of water borne sediment to between the gaps of the bars so as to build up the sea-bed under the mat and prevent seabed scouring. For example, all or selected ones of the tubular members may be formed with one or more vanes, ribs, fins, spikes, or corners projecting outwardly from their outer surface for the purpose of generating water current vortices which causes sediment to drop between the bars. With known cast concrete bars, this can also entail more complex and expensive shuttering on moulds.

The tubular members may be arranged in said predetermined spaced apart relationship by the use of a suitable jig or alternatively or additionally the required spacing can be achieved by spacer rings through which the ropes are also threaded.

Preferably, the flexible ropes are formed of a plastics material, for example, polypropylene.

An embodiment of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a schematic plan view of one form of pipeline stabilizing and protection mat in accordance with the invention,

Figure 2 is a similar plan view of a larger form of mat,

Figure 3 is an end view (partly broken away) to a large scale of the mats shown in Figures 1 or 2,

Figure 4 is a sectional view of one side of the mat, and

Figure 5 is a sectional view on the line V-V of Figure 4.

Referring first to Figures 1,2 and 3, for the ballast weight required to stabilize, for example, a 406 mm diameter pipeline on the sea bed, the mat will conveniently consist of sixteen elongate rigid bars 1 each of either 1 metre in length connected together by two rows of connecting means 2 (as shown in Figure 1), or of 2 metres in length connected together by four rows of connecting means 2 (as shown in Figure 2). The bars 1 are preferably spaced apart from one another by about 25mm, the first and last bars of the line of bars being provided with hook means 3 for subsequent connection to lifting apparatus (not shown) as aforesaid.

Referring also to Figures 4 and 5, in the manufacture of a mat in accordance with this particular embodiment of the invention, sixteen tubular members 4 formed from cut lengths of 150mm dia polythene piping are closed at their lower ends by fixed end caps 5 and are provided with pairs of diametrically opposed holes 6 formed through the walls thereof. In cases where it is thought desirable to reinforce the bars to be made, a number of reinforcing metal rods 7 and/or a reinforcing wire cage 7*a* (Figures 4 and 5) are supported by any suitable means (not shown) within each tubular member 4 leaving a clearance of about 40mm from each end thereof.

Each connecting means 2 consists of a length of 24mm diameter polypropylene rope 8 which is threaded through the appropriate pairs of holes 6 of all sixteen tubular members 4 which are positioned vertically in side-by-side relationship, e.g. in a suitable jig (not shown), so as to be spaced apart from each other as aforesaid, the ropes 8 then being pulled and held taut with its extreme ends either protruding by about 150mm outside the first and last tubular members, or alternatively to be contained (and possibly entwined in the reinforcing rods or cage 7,7a as shown in chain-dotted lines 8a in Figure 4) within the first and last tubular members.

Additionally or alternatively, the spacing apart of the tubular members may be determined by spacer rings 9 (shown in chain-dotted lines in Figure 4) through which the rope 8 will also be threaded alternately with an adjacent tubular member.

Each of the hook means 3 consists of an internally screw-threaded metal socket 11 having extending anchoring rods 12, and a screw-threaded eye bolt 13. The sockets 11 are firmly supported initially in apertures 14 formed in the outer facing wall of each of said first and last tubular members so that part of each socket 11 and its rods 12 project inside the appropriate tubular member with its screw thread facing outwardly for receiving the eye bolt 13 which is securely screwed therein, but which may be removed (e,g, by divers), subsequent to the use of the mat over a pipeline, for retention and re-use in the sockets of another mat.

The tubular members 4 may be provided with an integrally formed fin 15 (shown in chain-dotted lines in Figure 5) for the purpose of encouraging sediment precipitation as aforesaid.

The assembly of tubular members, arranged as just described, are then filled from their open ends by pouring and vibrating a concrete mix 16 so as to completely encapsulate the reinforcing rods or wire cage 7,7a (where used), the portions of rope 8, and the sockets 11 with their anchoring rods 12 contained within the tubular members which become a permanently retained encasement of the bars thus manufactured. The completed mat can be removed safely immediately the concrete filling is 'set' and, in fact, if time is of the essence, installation of the mat over a sub-marine pipeline can take place before the concrete has cured to its specified strength.

Depending upon the overall weight of mats required for a particular application, the quantity and density of the solid aggregate used in the concrete mix may be varied both in seive

sizing and material which could, for example, include iron ore fragments.

It will be understood that the diameter, length and number of bars to each mat will vary to suit the size of pipeline or other installation, the sea bed condition, and the extent of protusion above the sea bed. No definite rule can be applied to determine how many bars, or what length or diameter should be used. This has to be based on each particular application.

CLAIMS

1. A method of manufacturing a flexible pipeline stabilizing and protection mat, wherein there is provided a plurality of elongate tubular members closed at one end thereof and each formed with at least two pairs of holes spaced apart along its length, the holes of each pair of holes being substantially co-aligned in diametrically opposed walls of the tubular member, at least two lengths of flexible rope each of which is threaded through the respective aligned pairs of holes of the tubular members which are arranged in predetermined spaced parallel relationship with each other along the ropes, the first and last tubular members of said plurality of tubular members are provided with hook means, the tubular members then being filled from their open ends with concrete which completely encapsulate and anchor the portions of rope contained within the tubular members which become a permanently retained encasement part of each of the flexibly interconnected bars formed thereby.

2. A method according to Claim 1, wherein the encased concrete bars are further strenghened by the insertion within each tubular member before filling with concrete of a number of reinforcing metal rods or a pre-prepared cage of metal wire mesh supported within the tubular member and through which said rope portions will also be threaded or entwined and which is also encapsualted by the concrete filling.

3. A method according Claim 1 or Claim 2, wherein the hook means comprises at least two screw-threaded sockets members accessible through apertures formed in the outer wall of each first and last tubular members and permanently secured in the concrete filling, and a screw-threaded eye bolt removably fitted to each socket member so as to project externally of said first and last tubular members.

4. A method according to Claim 3, wherein each screw-threaded socket member is provided with an extended portion projecting within the tubular member, the socket member being initially supported at least in said apertures before said concrete filling is applied whereby the extended portion is also encapsulated by the concrete filling.

5. A method according to any preceding Claim, wherein the tubular members are formed of plastics material.

6. A method according to Claim 5, wherein the tubular members are formed of polythene or polypropylene.

7. A method according to Claim 5 or Claim 6, wherein the tubular members are of an easily recognisable bright colour.

8. A method according to Claim 7, wherein at least one of the centermost tubular members of the assembly of tubular members is of a contrasting easily distinguishable bright colour to the colour of the remaining tubular members.

9. A method according to any one of Claims 5,6,7 or 8, wherein all or selected ones of the tubular members are formed with one or more vanes, ribs, fins, spikes, or corners projecting outwardly from their outer surface.

10. A method according to any preceding Claim, wherein the tubular members are spaced apart by spacer rings through which said ropes are also threaded.

11. A method according to any preceding Claim, wherein the flexible rope is made of a plastics material.

12. A method according to Claim 11, wherein the flexible rope is made of polypropylene.

13. A method of manufacturing a flexible pipeline stabilizing and protection mat substantially as shown in and as hereinbefore described with reference to the accompanying drawings.

14. A flexible pipeline stabilizing and protection mat manufactured by a method in accordance with any preceding Claim.

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